International Journal of Research in Advent Technology, Vol.2, No.10, October 2014
E-ISSN: 2321-9637

Consequences of Enzyme Rinse on Physical Properties of Knit Garments

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Abstract-The use of enzymes in the textile chemical processing is rapidly gaining globally recognition because of their non-toxic and eco-friendly characteristics with the increasingly important requirements for textile manufactures to reduce pollution in textile production. Furthermore, the use of enzymes results in reduced process times, energy and water savings, improved product quality and potential process integration. Variation of knit fabric and enzyme concentration is taken to do this project. The aim is to know the effect of enzyme concentration on the physical properties of knit garments of various constructions. In this project 0.4 g/l and 0.5 g/l enzyme concentration is taken to wash Single Jersey and Rib fabric. Then to see the effect of enzyme concentration on the physical properties of Single Jersey and Rib fabric some tests like GSM, Bursting strength, Dimensional Stability and Pilling are done. The results of before and after enzyme wash is compared to know the effect of concentration of enzyme on the physical properties of Single Jersey and Rib fabric. After enzyme wash GSM of the fabric increases, Dimensional Stability and Bursting strength decreases and pilling formation on the fabric surface also decreases.
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Keywords- Enzyme; Single Jersey; Rib Fabric;Bursting Strength; Shrinkage, Pill formation

1. INTRODUCTION

Enzymes are proteins with highly specialized catalytic functions, produced by all living organisms. Enzymes are responsible for many essential biochemical reactions in microorganisms, plants, animals, and human beings. Enzymes are essential for all metabolic processes, but are not alive. Although like all other proteins, enzymes are composed of amino acids, they differ in function in that they have the unique ability to facilitate biochemical reactions without undergoing change themselves. This catalytic capability is what makes enzymes unique. Enzymes are natural protein molecules that act as highly efficient catalysts in biochemical reactions, that is, they help a chemical reaction take place quickly and efficiently. Enzymes not only work efficiently and rapidly, they are also biodegradable [1]. Enzymes are highly efficient in increasing the reaction rate of biochemical processes that otherwise proceed very slowly, or in some cases, not at all. Enzymes play a diversified role in many aspects of everyday life including aiding in digestion, the production of food and several industrial applications. Enzymes are nature's catalysts. Humankind has used them for thousands of years to carry out important chemical reactions for making products such as cheese, beer, and wine. Bread and yogurt also owe their flavor and texture to a range of enzyme producing organisms that were Domesticated many years ago. Enzymes can often replace chemicals or processes that present safety or environmental issues. Enzymes can replace acids in the starch processing industry and alkalis or oxidizing agents in fabric desizing [3]. It also replaces pumice stones for stonewashing jeans and remove stains from fabrics. Enzymes can be used instead of chlorine bleach for removing stains on cloth. The use of enzymes also allows the level of surfactants to be reduced and permits the cleaning of clothes in the absence of phosphates. Enzymes also contribute to safer working conditions through elimination of chemical treatments during production processes [4].

2. MATERIALS USED FOR EXPERIMENT

In this experiment variation of enzyme concentration is done to know the effect of enzyme concentration on the physical properties of knit garments of various constructions. The materials which are used to do this experiment are given below-

Single Jersey Fabric: Fabric construction: 95% cotton, 5% lycra.Fabric GSM: 168**, Rib Fabric:**Fabric construction: 95% cotton, 5% lycra.Fabric GSM: 206**, Enzyme:** Acid enzyme is used in this project. **Acetic Acid and Water are also used.**

3. METHODOLOGY

The following tests are done to know the effect of enzyme concentration on the physical properties of Single Jersey and Rib fabric -
Bursting Strength Test
Gram per Square Meter (G.S.M)
Dimensional Stability Test
Pilling Test

3.1 Bursting strength Test

The bursting strength of Single Jersey and Rib fabric is done according to**BS EN ISO 13938-2:1999.**
Bursting strength is an alternative method of measuring strength in which the material is stressed in all directions at the same time and is therefore more suitable for such materials. There are also fabrics which are simultaneously stressed in all directions during service, such as parachute fabrics, filters, sacks and nets, where it may be important to stress them in a realistic manner.

3.2 GSM Test

GSM test of Single Jersey and Rib fabric is done according to**ASTM D 3776**. The standard temperature and relative humidity which is respectively 25C and 67% is also maintained.

Fabric GSM means grams per square meter of a knit, woven or non-woven fabric. This test can be carried out in different ways but it is very easy to know the weight of the fabric by cutting the fabric with the GSM cutter [7].

3.3 Dimensional Stability Test

Dimensional stability of Single Jersey and Rib fabric is done according toast D6207**.**Dimensional stability is the vital characteristics of a fabric. By this test, we can be confirming about the shrinkage and spirility properties of a fabric. After dyeing and finishing operation; dimensional stability test is carried out. Dimensional properties can be changed by stentering, compacting or by treating the fabric with finishing chemicals. For conditioning the sample is put in the table for 4 hours. Cut the sample 48 x 48 cm & benchmark should be 35 x 35 cm. Stitch the sample (3 sides) by over lock machine. Put sample in washing machine and run for 50 minutes. Drying: Dry the fabric with tumble Dry [6].

3.4 Shrinkage test calculation

Shrinkage % = (Before wash – After Wash) / Before Wash

3.5 Pilling test

Pilling test of Single Jersey and Rib fabric is done according to ASTM D4970 / (2010[8].The pills are formed during wear and washing by the entanglement of loose fibers which protrude from the fabric surface. Under the influence of the rubbing action these loose fibers develop into small spherical bundles anchored to the fabric by a few unbroken fibers. A piece of fabric measuring 10×10 inch is sewn to a firm fit when placed round a rubber tube. The out end of the fabrics is covered by cellophane tape and metal plates are placed on the tester .Run the tester for 2000 cycles. Remove the sample and compare the sample with standard scale.

4. RESULT

4. 1 Result of GSM Test

A. Single Jersey Fabric: GSM of Single Jersey fabric which is found before and after enzyme wash are given below-

Table 1: GSM of Single jersey fabric before enzyme wash

Observation No.	GSM	Average
1	169.6 gm.	
2	169.2 gm.	168.5 gm.
3	166.6 gm.	

Table 2: GSM of Single jersey fabric after enzyme wash (0.4 g/l)

Observation No.	GSM	Average
1	190.7 gm.	
2	189.6 gm.	190.2 gm.
3	190.3 gm.	

Table 3: GSM of Single jersey fabric after enzyme wash (0.5 g/l)

Observation No.	GSM	Average
1	189.2 gm.	
2	197.4 gm.	192.7 gm.
3	191.5 gm.	

B. Rib (2*2) Fabric: GSM of Rib fabric which is found before and after enzyme wash are given below-
Table 4: GSM of Rib fabric before enzyme wash

Observation No.	GSM	Average
1	201.1 gm.	
2	210.1 gm.	206.1 gm.
3	207.1 gm.	

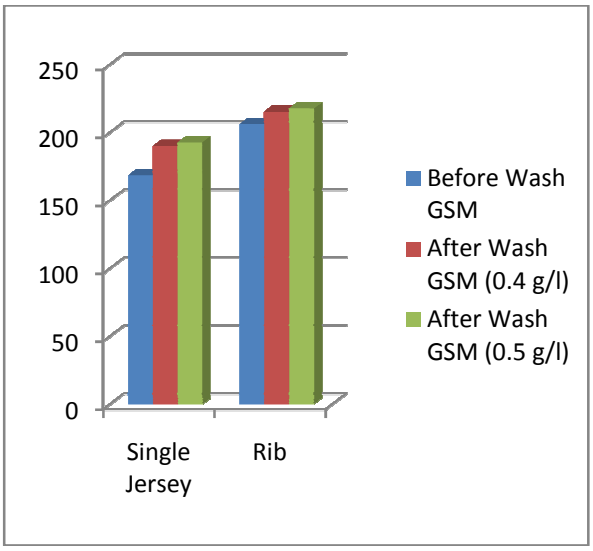
Table 5: GSM of Rib fabric after enzyme wash (0.4 g/l)

Observation No.	GSM	Average
1	207.9 gm.	
2	218.8 gm.	215.4 gm.
3	219.6 gm.	

Table 6: GSM of Rib fabric after enzyme wash (0.5 g/l)

Observation No.	GSM	Average
1	221.5 gm.	
2	217.4 gm.	217.7 gm.
3	214.3 gm.	

Graph 1: Comparison of GSM of Single Jersey fabric and Rib fabric before and after enzyme wash in different concentration.



4.2 Result of Bursting Strength Test

A.Single jersey Fabric: Bursting Strength of Single Jersey fabric which is found before and after enzyme wash are given below-

Table 7: Bursting strength of Single Jersey Fabric before wash

Observation No.	Bursting Strength (KPa)
1	387.5
2	385.0
3	378.6
Average	383.7

Table 8: Bursting strength of Single Jersey Fabric after enzyme wash (0.4 g/l)

Observation No.	Bursting Strength (KPa)
1	366.2
2	373.1
3	363.0
Average	367.4

Table 9: Bursting strength of Single Jersey Fabric after enzyme wash (0.5 g/l)

Observation No.	Bursting Strength (KPa)
1	374.1
2	337.4
3	364.2
Average	358.6

B. Rib Fabric: Bursting Strength of Single Jersey fabric which is found before and after enzyme wash are given below-

Table 10: Bursting strength of Rib Fabric before wash

Observation No.	Bursting Strength (KPa)
1	396.1
2	395.8
3	378.6
Average	384.1

Table 11: Bursting strength of Rib Fabric after enzyme wash (0.4 g/l)

Observation No.	Bursting Strength (KPa)
1	381.1
2	376.2
3	384.8
Average	380.7

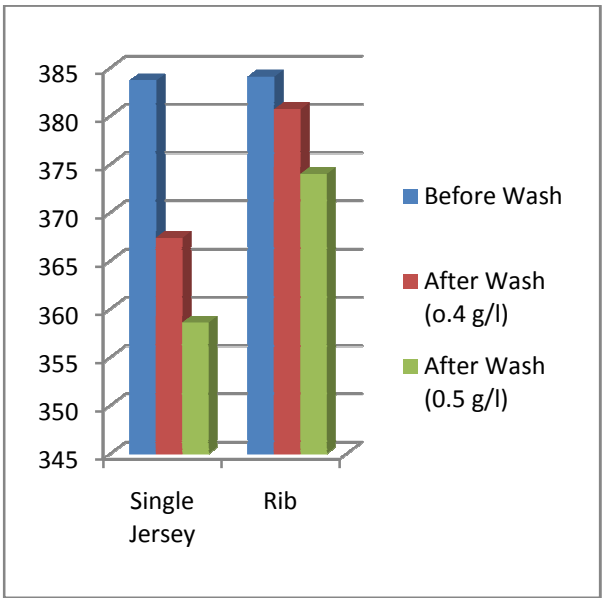
Table 12: Bursting strength of Rib Fabric after enzyme wash (0.5 g/l)

Observation No.	Bursting Strength (KPa)
1	382.3
2	384.3
3	355.5
Average	374.0

Table 13: Bursting strength of Single Jersey fabric and Rib fabric before and after enzyme wash in different concentration.

Fabric	Before Wash Bursting Strength (KPa)	After Wash (0.4 g/l) Bursting Strength (KPa)	After Wash (0.5 g/l) Bursting Strength (KPa)
Single Jersey	383.7	367.4	358.6
Rib	384.1	380.7	374.0

Graph 2: Comparison of Bursting strength of Single Jersey fabric and Rib fabric before and after enzyme wash in different concentration.



4.3 Result of Dimensional Stability Test

A. Single Jersey Fabric: Dimensional Stability of Single Jersey fabric which is found before and after enzyme wash are given below-

Table 14: Dimensional Stability of Single Jersey Fabric before wash

	Length wise shrinkage	Width wise shrinkage	Twist
Before Wash	0	0	0

Table 15: Dimensional Stability of Single Jersey Fabric after enzyme wash (0.4 g/l)

	Length wise shrinkage	Width wise shrinkage	Twist
After Wash (0.4 g/l)	0.95%	0.87%	0.49%

Table 16: Dimensional Stability of Single Jersey Fabric after enzyme wash (0.5 g/l)

	Length wise shrinkage	Width wise shrinkage	Twist
After Wash (0.5 g/l)	0.66%	0.64%	0.27%

B. Rib Fabric: Dimensional Stability of Rib fabric which is found before and after enzyme wash are given below-

Table 17: Dimensional Stability of Rib Fabric before wash

	Length wise shrinkage	Width wise shrinkage	Twist
Before Wash	0	0	0

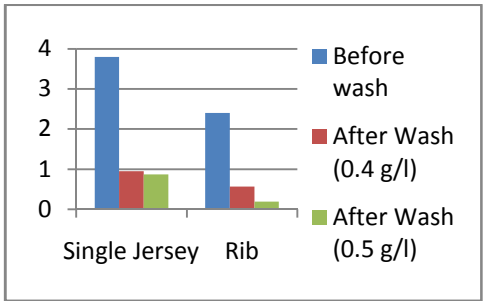
Table 18: Dimensional Stability of Rib Fabric after enzyme wash (0.4 g/l)

	Length wise shrinkage	Width wise shrinkage	Twist
After Wash (0.4 g/l)	0.57%	4.02%	0%

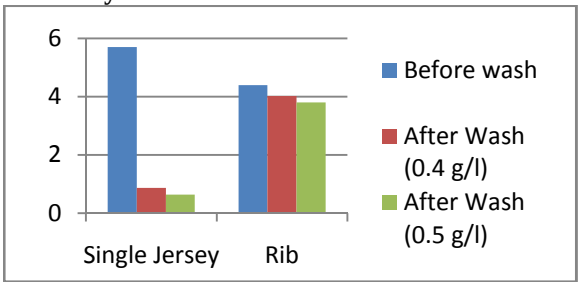
Table 19: Dimensional Stability of Rib Fabric after enzyme wash (0.5 g/l)

	Length wise shrinkage	Width wise shrinkage	Twist
After Wash (0.5 g/l)	0.19%	3.80%	0%

Graph 3: Comparison of Length Wise Shrinkage of Single Jersey fabric and Rib fabric before and after enzyme wash in different concentration.



Graph 4: Comparison of Width Wise Shrinkage of Single Jersey fabric and Rib fabric before and after enzyme wash in different concentration.



Graph 5: Comparison of Twist of Single Jersey fabric and Rib fabric before and after enzyme wash in different concentration.

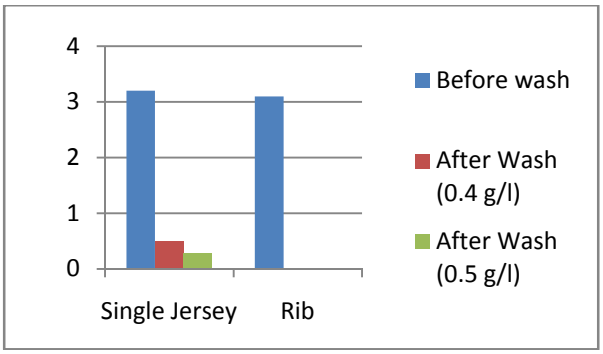


Table20: Comparison of rating of Pilling of Single Jersey fabric and Rib fabric after enzyme wash in different concentration.

Single Jersey Fabric		Rib Fabric	
Concentration	Rating	Concentration	Rating
0.4 g/l	2	0.4 g/l	4
0.5 g/l	2	0.5 g/l	4

5. CONCLUSION

At the end of this study it has been found that when enzyme wash is applied on the knit garments it increases the GSM of knit garments, it reduce the hairy fibers from the fabric surface and because of that bursting strength of knit garment decreases, dimensional stability and pilling formation of knit garments also decreases. Again with the increasingly important requirement for textile manufacturers to reduce pollution in textile production, the use of enzymes in the chemical processing of fibers and textiles is rapidly gaining wider recognition because of their non-toxic and eco-friendly characteristics. They can be safely used in a wide selection of textile processes such as de-sizing, scouring, bleaching, dyeing and finishing, where the alternatives are very harsh chemicals whose disposal into the environment causes many problems. Now a day's application of enzyme in washing is increasing day by day for preparing a well good enough knit garments.

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